CLAIMS:

1. A portable oxygen delivery control apparatus for controlling a flow of oxygen to a user in an open-loop breathing system including an oxygen supply and a delivery apparatus for delivering supplemental oxygen to a user comprising:

an oximeter arranged to measure a blood-oxygen saturation level of a user and provide an output signal indicative of said blood-oxygen saturation level;

a valve, a first port of said valve adapted to be connected to said oxygen supply and a second port adapted to be connected to said delivery apparatus, said valve having a first position permitting oxygen to flow from said supply to said delivery apparatus, and a second position preventing oxygen from flowing from said supply to said delivery apparatus;

a pressure sensor, said sensor associated with a said valve, said sensor arranged to detect a period of inhalation by said user by detecting a condition of reduced pressure associated with said delivery apparatus for delivering supplemental oxygen to a user when said valve is in said second position;

a selector adapted to accept a target blood-oxygen saturation level;

a flow sensor, said flow sensor positioned along a flow path between said oxygen supply and said delivery apparatus, said flow sensor configured to generate information regarding a flow rate of oxygen delivered from said oxygen supply to said user; and

a processor arranged to calculate a time period which said valve should be maintained in its first position to cause a desired amount of oxygen to be delivered to said user when said oximeter indicates a blood-oxygen saturation level which is below said goal blood-oxygen saturation level and arranged to generate a signal for said time period, which signal applied to said valve moves said valve to said first position and causes oxygen to be delivered to said user when a condition of inhalation is detected by said pressure sensor, and said signal when removed from said valve causes said valve to be moved to said second position.

2. The apparatus in accordance with claim 1 including a memory associated with said processor, said memory configured to store flow rate information.

3. The apparatus in accordance with claim 1 wherein said processor, flow sensor, valve and pressure sensor are associated with said processor and said selector comprises a user-actuatable input.

4. The apparatus in accordance with claim 1 wherein said pressure sensor comprises a diaphragm exposed to the atmosphere on opposing sides so as to be altitude correcting.

5. A method of controlling a flow of supplemental oxygen from an oxygen supply to a user through a delivery apparatus in an open-loop breathing system, the delivery apparatus including a valve moveable between a first position permitting oxygen to flow from said supply to said user and a second position for preventing oxygen to flow from said supply to said user comprising the steps of:

receiving a goal blood-oxygen saturation level of a user;

determining an actual blood-oxygen saturation level of a user;

determining a length of time said valve should be moved to said first position in order to deliver a desired quantity of oxygen to achieve said goal blood-oxygen saturation level based upon said actual blood-oxygen saturation level;

detecting the initiation of inhalation by said user;

moving said valve from said second position to said first position for said determined length of time when said inhalation is detected;

returning said valve to said second position; and

generating information regarding an average flow rate of oxygen delivered from said supply to said user;

determining if a change in average flow rate exceeds a predetermined amount and, if so, triggering an alarm.

6. The method in accordance with claim 5 wherein said step of determining a blood-oxygen saturation level comprises measuring a blood-oxygen saturation level of said user with a pulse-oximeter.

7. The method in accordance with claim 5 wherein said step of determining the initiation of inhalation by a user comprises sensing a drop in pressure at said delivery apparatus.

8. The method in accordance with claim 5 wherein said predetermined amount comprises a predetermined percentage change in average flow rate.

9. The method in accordance with claim 5 wherein said step of triggering an alarm comprises illuminating a light.

10. The method in accordance with claim 5 wherein said step of triggering an alarm comprises emitting an audible noise.

11. The method in accordance with claim 5 including the step of storing flow rate information received from said output of said flow sensor and utilizing said stored information to generate said average flow rate.

12. The method in accordance with claim 5 wherein said step of generating information regarding an average flow rate comprises generating flow rate information with a flow sensor and utilizing said flow rate information to generate information regarding average flow rate.

13. A method of controlling a flow of oxygen from an oxygen supply to a user comprising the following steps:

providing an amount of oxygen to a user in a breathing system, said amount of oxygen determined by comparing a desired blood-oxygen content level with a

measured blood-oxygen content level, said amount of oxygen delivered to said user when a period of inhalation of said user is detected, said amount of oxygen provided to said user continuously automatically adjusted based upon said desired and measured blood-oxygen content levels; and

determining an average dose time, said average dose time indicative of the average flow rate of oxygen delivered to said user and triggering an alarm if said average dose time changes by an amount exceeding a predetermined amount.

14. The method in accordance with claim 13 including the step of opening a valve to provide said amount of oxygen.

15. A method of controlling a flow of supplemental oxygen from an oxygen supply to a user through a delivery apparatus in an open-loop breathing system, the delivery apparatus including a valve moveable between a first position to flow from said supply to said user and a second position for preventing oxygen to flow from said supply to said user, comprising the steps of:

receiving a goal blood-oxygen saturation level of a user;

determining an actual blood-oxygen saturation level of a user;

determining a breath rate of said user;

sensing periods of inhalation by said user;

determining a length of time said valve should be moved to said first position in order to deliver a desired quantity of oxygen, said determining step comprising determining a maximum time said valve should be moved to said first position, determining a minimum time said valve should be moved to said first position, and determining a variable time said valve should be moved to said first position;

detecting the initiation of inhalation by said user; and

moving said valve from said second position to said first position for said determined length of time; and

returning said valve to said second position.

16. The method in accordance with claim 15 wherein said step of determining a blood oxygen saturation level comprises measuring a blood-oxygen saturation level of said user with a pulse-oximeter.

17. The method in accordance with claim 15 wherein said step of determining the initiation of inhalation by a user comprises sensing a drop in pressure at said delivery apparatus.

18. The method in accordance with claim 15 wherein said desired quantity of oxygen comprises a maximum quantity when said actual blood-oxygen saturation level is below said goal blood-oxygen saturation level.

19. The method in accordance with claim 15 wherein said desired quantity of oxygen comprises a linearly changing quantity between a minimum quantity corresponding to said minimum time and a maximum quantity corresponding to said maximum time.

20. The method in accordance with claim 15 wherein said step of moving said valve comprises applying a signal to said valve causing said valve to be retained in its first position for said determined length of time.

21. A portable oxygen delivery control apparatus for controlling a flow of oxygen to a user in an open-loop breathing system including an oxygen supply and a delivery apparatus for delivering supplemental oxygen to a user comprising:

an oximeter arranged to measure a blood-oxygen saturation level of a user and provide an output signal indicative of said blood-oxygen saturation level;

a valve, a first port of said valve adapted to be connected to said oxygen supply and a second port adapted to be connected to said delivery apparatus, said valve having a first position permitting oxygen to flow from said supply to said

delivery apparatus, and a second position preventing oxygen from flowing from said supply to said delivery apparatus;

a pressure sensor, said sensor associated with a said valve, said sensor arranged to detect a period of inhalation by said user;

a selector adapted to accept a target blood-oxygen saturation level;

an average dose time calculator adapted to determine an amount of oxygen delivered to said user from said oxygen supply; and

a processor arranged to calculate a dose time period which said valve should be maintained in its first position to cause a desired amount of oxygen to be delivered to said user when said oximeter indicates a blood-oxygen saturation level which is below said goal blood-oxygen saturation level and arranged to generate a signal for said dose time period, which signal applied to said valve moves said valve to said first position and causes oxygen to be delivered to said user when a condition of inhalation is detected by said pressure sensor, and said signal when removed from said valve causes said valve to be moved to said second position, and said processor configured to utilize average dose time information generated by said average dose time calculator and trigger an alarm in the event said amount of oxygen delivered to said user from said oxygen supply meets a predetermined criteria.

22. The apparatus in accordance with claim 21 including a memory associated with said processor, said memory configured to store said average dose time information.

23. The apparatus in accordance with claim 21 wherein said alarm comprises an audible warning.

24. The apparatus in accordance with claim 21 wherein said alarm comprises a visual warning.

25. The apparatus in accordance with claim 21 wherein said processor, flow sensor, valve and pressure sensor are associated with a printed circuit board located within a housing and said selector comprises a user-actuatable input extending from said housing.

26. The apparatus in accordance with claim 21 wherein said pressure sensor comprises a diaphragm exposed to the atmosphere on opposing sides so as to be altitude correcting.

27. A method of controlling a flow of supplemental oxygen from an oxygen supply to a user through a delivery apparatus in an open-loop breathing system, the delivery apparatus including a valve moveable between a first position permitting oxygen to flow from said supply to said user and a second position for preventing oxygen to flow from said supply to said user comprising the steps of:

receiving a goal blood-oxygen saturation level of a user;

determining an actual blood-oxygen saturation level of a user;

determining a length of time said valve should be moved to said first position in order to deliver a desired quantity of oxygen to achieve said goal blood-oxygen saturation level based upon said actual blood-oxygen saturation level;

detecting the initiation of inhalation by said user;

moving said valve from said second position to said first position for said determined length of time when said inhalation is detected;

returning said valve to said second position;

generating information regarding an average dose time of oxygen delivered from said supply to said user; and

determining if a change in said average dose time exceeds a predetermined amount and, if so, triggering an alarm.

28. The method in accordance with claim 27 wherein said step of determining a blood-oxygen saturation level comprises measuring a blood-oxygen saturation level of said user with a pulse-oximeter.

29. The method in accordance with claim 27 wherein said step of determining the initiation of inhalation by a user comprises sensing a drop in pressure at said delivery apparatus.

30. The method in accordance with claim 27 wherein said step of triggering an alarm comprises illuminating a light.

31. The method in accordance with claim 27 wherein said step of triggering an alarm comprises emitting an audible noise.

32. The method in accordance with claim 27 including the step of storing current dose time information and utilizing said stored current does time information to generate said average dose time.

33. A portable oxygen delivery control apparatus for controlling a flow of oxygen to a user in an open-loop breathing system including an oxygen supply and a delivery apparatus for delivering supplemental oxygen to a user comprising:

an oximeter arranged to measure a blood-oxygen saturation level of a user and provide an output signal indicative of said blood-oxygen saturation level;

a valve, a first port of said valve adapted to be connected to said oxygen supply and a second port adapted to be connected to said delivery apparatus, said valve having a first position permitting oxygen to flow from said supply to said delivery apparatus, and a second position preventing oxygen from flowing from said supply to said delivery apparatus;

a pressure sensor, said sensor associated with a said valve, said sensor including a diaphragm exposed to the atmosphere on opposing sides so as to be

altitude correcting and arranged to detect a period of inhalation by said user by detecting a condition of reduced pressure associated with said delivery apparatus for delivering supplemental oxygen to a user when said valve is in said second position;

a selector adapted to accept a target blood-oxygen saturation level;

a flow sensor, said flow sensor positioned along a flow path between said oxygen supply and said delivery apparatus, said flow sensor configured to generate information regarding a flow rate of oxygen delivered from said oxygen supply to said user; and

a processor arranged to calculate a time period which said valve should be maintained in its first position to cause a desired amount of oxygen to be delivered to said user when said oximeter indicates a blood-oxygen saturation level which is below said goal blood-oxygen saturation level and arranged to generate a signal for said time period, which signal applied to said valve moves said valve to said first position and causes oxygen to be delivered to said user when and a condition of inhalation is detected by said pressure sensor, and said signal when removed from said valve causes said valve to be moved to said second position, and said processor configured to utilize flow rate information generated by said flow sensor and trigger an alarm in the event said utilized flow rate information meets a predetermined criteria.

34. The apparatus in accordance with claim 33 including a memory associated with said processor, said memory configured to store flow rate information.

35. The apparatus in accordance with claim 33 wherein said alarm comprises an audible warning.

36. The apparatus in accordance with claim 33 wherein said alarm comprises a visual warning.

37. The apparatus in accordance with claim 33 wherein said processor, flow sensor, valve and pressure sensor are associated with a printed circuit board located within a housing and said selector comprises a user-actuatable input extending from said housing.

38. A method of controlling a flow of supplemental oxygen from an oxygen supply to a user through a delivery apparatus in an open-loop breathing system, the delivery apparatus including a valve moveable between a first position permitting oxygen to flow from said supply to said user and a second position for preventing oxygen to flow from said supply to said user comprising the steps of:

receiving a goal blood-oxygen saturation level of a user;

determining an actual blood-oxygen saturation level of a user;

determining a length of time said valve should be moved to said first position in order to deliver a desired quantity of oxygen to achieve said goal blood-oxygen saturation level based upon said actual blood-oxygen saturation level;

detecting the initiation of inhalation by said user;

moving said valve from said second position to said first position for said determined length of time when said inhalation is detected;

returning said valve to said first position; and

generating at two or more times information regarding an average flow rate of oxygen delivered from said supply to said user;

determining if a change in average flow rate exceeds a predetermined amount and, if so, triggering an alarm.

39. The method in accordance with claim 38 wherein said step of determining a blood-oxygen saturation level comprises measuring a blood-oxygen saturation level of said user with a pulse-oximeter.

40. The method in accordance with claim 38 wherein said step of determining the initiation of inhalation by a user comprises sensing a drop in pressure at said delivery apparatus.

41. The method in accordance with claim 38 wherein said predetermined amount comprises a predetermined percentage change in average flow rate.

42. The method in accordance with claim 38 wherein said step of triggering an alarm comprises illuminating a light.

43. The method in accordance with claim 38 wherein said step of triggering an alarm comprises emitting an audible noise.

44. The method in accordance with claim 38 including the step of storing flow rate information received from said output of said flow sensor and utilizing said stored information to generate said average flow rate.

45. The method in accordance with claim 38 wherein said step of generating information regarding an average flow rate comprises generating flow rate information with a flow sensor and utilizing said flow rate information to generate information regarding average flow rate.

46. A method of controlling a flow of oxygen from an oxygen supply to a user comprising the following steps:

providing an amount of oxygen to a user in a breathing system, said amount of oxygen determined by comparing a desired blood-oxygen content level with a measured blood-oxygen content level, said amount of oxygen delivered to said user when a period of inhalation of said user is detected, said amount of oxygen provided to said user continuously automatically adjusted based upon said desired and measured blood-oxygen content levels; and

determining an average flow rate of oxygen delivered to said user and triggering an alarm if said overage flow rate of oxygen changes by an amount exceeding a predetermined amount.

47. The method in accordance with claim 46 including the step of opening a valve to provide said amount of oxygen.

48. The method in accordance with claim 46 including the step of utilizing flow rate data received as an output of a flow sensor to calculate said average flow rate.

49. The method in accordance with claim 46 including the step of storing said flow rate data.

50. A method of controlling a flow of supplemental oxygen from an oxygen supply to a user through a delivery apparatus in an open-loop breathing system, the delivery apparatus including a valve moveable between a first position to flow from said supply to said user and a second position for preventing oxygen to flow from said supply to said user, comprising the steps of:

receiving a goal blood-oxygen saturation level of a user;

determining an actual blood-oxygen saturation level of a user;

determining a breath rate of said user;

sensing periods of inhalation by said user;

determining a length of time said valve should be moved to said first position in order to deliver a desired quantity of oxygen, said determining step comprising determining a first maximum time if said actual level has not reached said goal level or said actual level is below a minimum level, determining a second minimum time if said actual level is above said goal level, and determining a variable time if said actual level has at least once reached said goal level but said actual level is between said minimum level and said goal level, said step of determining a variable time including determining a breath rate of said user from

said sensed periods of inhalation by said user, determining a delivery volume comprising a desired quantity of oxygen divided by said breath rate, and determining said variable time by dividing said delivery volume by a flow rate of supplemental oxygen available;

detecting the initiation of inhalation by said user; and

moving said valve from said second position to said first position for said determined length of time; and

returning said valve to said first position.

51. The method in accordance with claim 50 wherein said step of determining a blood oxygen saturation level comprises measuring a blood-oxygen saturation level of said user with a pulse-oximeter.

52. The method in accordance with claim 50 wherein said step of determining the initiation of inhalation by a user comprises sensing a drop in pressure at said delivery apparatus.

53. The method in accordance with claim 50 wherein said desired quantity of oxygen comprises a maximum quantity when said actual level is below said minimum level.

54. The method in accordance with claim 50 wherein said desired quantity of oxygen comprises a linearly changing quantity between a minimum quantity corresponding to said minimum time and a maximum quantity corresponding to said maximum time.

55. The method in accordance with claim 50 wherein said step of moving said valve comprises applying a signal to said valve causing said valve to be retained in its first position for said determined length of time.

56. The method in accordance with claim 50 wherein said determined length of time does not exceed one-half of an inhalation time of said user.

57. A portable oxygen delivery control apparatus for controlling a flow of oxygen to a user in an open-loop breathing system including an oxygen supply and a delivery apparatus for delivering supplemental oxygen to a user comprising:

an oximeter arranged to measure a blood-oxygen saturation level of a user and provide an output signal indicative of said blood-oxygen saturation level;

a valve, a first port of said valve adapted to be connected to said oxygen supply and a second port adapted to be connected to said delivery apparatus, said valve having a first position permitting oxygen to flow from said supply to said delivery apparatus, and a second position preventing oxygen from flowing from said supply to said delivery apparatus;

a pressure sensor, said sensor associated with a said valve, said sensor including a diaphragm exposed to the atmosphere on opposing sides so as to be altitude correcting and arranged to detect a period of inhalation by said user by detecting a condition of reduced pressure associated with said delivery apparatus for delivering supplemental oxygen to a user when said valve is in said second position;

a selector adapted to accept a target blood-oxygen saturation level;

a flow sensor, said flow sensor positioned along a flow path between said oxygen supply and said delivery apparatus, said flow sensor configured to generate information regarding a flow rate of oxygen delivered from said oxygen supply to said user; and

a processor arranged to calculate a time period which said valve should be maintained in its first position to cause a desired amount of oxygen to be delivered to said user when said oximeter indicates a blood-oxygen saturation level which is below said goal blood-oxygen saturation level and arranged to generate a signal for said time period, which signal applied to said valve moves said valve to said first position and causes oxygen to be delivered to said user when a condition of inhalation is detected by said pressure sensor, and said signal when removed from

said valve causes said valve to be moved to said second position, and said processor configured to utilize flow rate information generated by said flow sensor and trigger an alarm in the event said utilized flow rate information meets a predetermined criteria.

58. The apparatus in accordance with claim 57 including a memory associated with said processor, said memory configured to store flow rate information.

59. The apparatus in accordance with claim 57 wherein said alarm comprises an audible warning.

60. The apparatus in accordance with claim 57 wherein said alarm comprises a visual warning.

61. The apparatus in accordance with claim 57 wherein said processor, flow sensor, valve and pressure sensor are associated with a printed circuit board located within a housing and said selector comprises a user-actuatable input extending from said housing.

62. A method of controlling a flow of supplemental oxygen from an oxygen supply to a user through a delivery apparatus in an open-loop breathing system, the delivery apparatus including a valve moveable between a first position permitting oxygen to flow from said supply to said user and a second position for preventing oxygen to flow from said supply to said user comprising the steps of:

receiving a goal blood-oxygen saturation level of a user;

determining an actual blood-oxygen saturation level of a user;

determining a length of time said valve should be moved to said first position in order to deliver a desired quantity of oxygen to achieve said goal blood-oxygen saturation level based upon said actual blood-oxygen saturation level;

detecting the initiation of inhalation by said user;

moving said valve from said second position to said first position for said determined length of time when said inhalation is detected;

returning said valve to said second position; and

generating at two or more times information regarding an average flow rate of oxygen delivered from said supply to said user;

determining if a change in average flow rate exceeds a predetermined amount and, if so, triggering an alarm.

63. The method in accordance with claim 62 wherein said step of determining a blood-oxygen saturation level comprises measuring a blood-oxygen saturation level of said user with a pulse-oximeter.

64. The method in accordance with claim 62 wherein said step of determining the initiation of inhalation by a user comprises sensing a drop in pressure at said delivery apparatus.

65. The method in accordance with claim 62 wherein said predetermined amount comprises a predetermined percentage change in average flow rate.

66. The method in accordance with claim 62 wherein said step of triggering an alarm comprises illuminating a light.

67. The method in accordance with claim 62 wherein said step of triggering an alarm comprises emitting an audible noise.

68. The method in accordance with claim 62 including the step of storing flow rate information received from said output of said flow sensor and utilizing said stored information to generate said average flow rate.

69. The method in accordance with claim 62 wherein said step of generating information regarding an average flow rate comprises generating flow rate information with a flow sensor and utilizing said flow rate information to generate information regarding average flow rate.

70. A method of controlling a flow of oxygen from an oxygen supply to a user comprising the following steps:

providing an amount of oxygen to a user in a breathing system, said amount of oxygen determined by comparing a desired blood-oxygen content level with a measured blood-oxygen content level, said amount of oxygen delivered to said user when a period of inhalation of said user is detected, said amount of oxygen provided to said user continuously automatically adjusted based upon said desired and measured blood-oxygen content levels; and

determining an average flow rate of oxygen delivered to said user and triggering an alarm if said average flow rate of oxygen changes by an amount exceeding a predetermined amount.

71. The method in accordance with claim 70 including the step of opening a valve to provide said amount of oxygen.

72. The method in accordance with claim 70 including the step of utilizing flow rate data received as an output of a flow sensor to calculate said average flow rate.

73. The method in accordance with claim 70 including the step of storing said flow rate data.

74. A method of controlling a flow of supplemental oxygen from an oxygen supply to a user through a delivery apparatus in an open-loop breathing system, the delivery apparatus including a valve moveable between a first position to flow from

said supply to said user and a second position for preventing oxygen to flow from said supply to said user, comprising the steps of:

receiving a goal blood-oxygen saturation level of a user;

determining an actual blood-oxygen saturation level of a user;

determining a breath rate of said user;

sensing periods of inhalation by said user;

determining a length of time said valve should be moved to said first position in order to deliver a desired quantity of oxygen, said determining step comprising determining a first maximum time if said actual level has not reached said goal level or said actual level is below a minimum level, determining a second minimum time if said actual level is above said goal level, and determining a variable time if said actual level has at least once reached said goal level but said actual level is between said minimum level and said goal level, said step of determining a variable time including determining a breath rate of said user from said sensed periods of inhalation by said user, determining a delivery volume comprising a desired quantity of oxygen divided by said breath rate, and determining said variable time by dividing said delivery volume by a flow rate of supplemental oxygen available;

detecting the initiation of inhalation by said user; and

moving said valve from said second position to said first position for said determined length of time; and

returning said valve to said second position.

75. The method in accordance with claim 74 wherein said step of determining a blood oxygen saturation level comprises measuring a blood-oxygen saturation level of said user with a pulse-oximeter.

76. The method in accordance with claim 74 wherein said step of determining the initiation of inhalation by a user comprises sensing a drop in pressure at said delivery apparatus.

77. The method in accordance with claim 74 wherein said desired quantity of oxygen comprises a maximum quantity when said actual level is below said minimum level.

78. The method in accordance with claim 74 wherein said desired quantity of oxygen comprises a linearly changing quantity between a minimum quantity corresponding to said minimum time and a maximum quantity corresponding to said maximum time.

79. The method in accordance with claim 74 wherein said step of moving said valve comprises applying a signal to said valve causing said valve to be retained in its first position for said determined length of time.

80. The method in accordance with claim 74 wherein said determined length of time does not exceed one-half of an inhalation time of said user.